

CLAIM:

1. A method for transmitting data between multiple pairs of origin nodes and destination nodes on a mesh network having a plurality of nodes interconnected via links, comprising for a pair of communicating nodes:
 - establishing a working virtual connection comprising a working path and a procedure for transferring data along the working path, the working path comprising a plurality of working path nodes, including an origin node and a destination node, and links interconnecting the working path nodes; each working path node including information defining the working virtual connection;
 - establishing a protection virtual connection comprising a protection path and a procedure for transferring data along the protection path, the protection path comprising a plurality of protection path nodes, including the origin node and the destination node, and links interconnecting the protection path nodes each protection path node including information defining the protection virtual connection;
 - transmitting data from the origin node to the destination node over the working virtual connection;
 - detecting a failure along the working path and transmitting a failure notification to the origin and destination nodes;

receiving the failure notification at the origin and destination nodes and relating this notification to virtual connections affected by the failure;

automatically ceasing transmission of data over the working virtual connections affected by the failure, and automatically transmitting data over the protection virtual connections corresponding to the working virtual connections affected by the failure; and

automatically ceasing the reception of data over the working virtual connections affected by the failure, and automatically receiving data over the protection virtual connections corresponding to the working virtual connections affected by the failure;

wherein:

establishing a working virtual connection comprises selecting at a working path node a link from a set of all links connected to the working path node;

establishing a protection virtual connection comprises selecting at a protection path node a link from a set of all links connected to the node, such that the protection path and its associated working path have no links in common and no nodes in common except for the source and destination nodes; and

a node may simultaneously function as source node for multiple virtual connections, a destination node for multiple virtual connections, and an intermediate node for multiple virtual connections.

2. A method as recited in claim 1, comprising:

establishing a plurality of working connections, including at least one working physical connection, the working physical connection comprising a working path and a set of channels allocated to the working physical connection;

establishing a plurality of protection connections, including at least one protection physical connection, the protection physical connection comprising a protection path and a set of channels allocated to the protection physical connection;

transmitting data through at least one working physical connection, simultaneously transmitting through the protection physical connection associated with the at least one working physical connection;

simultaneously receiving the data at the destination node from both the working physical connection and the protection physical connection;

selecting the data from the working physical connection;

detecting a failure on the working physical connection; and

selecting data from the associated protection physical connection.

3. A method as recited in claim 2, comprising classifying data according to time sensitivity and applying the method of claim 2 only to data with the highest time sensitivity.
4. A method as recited in claim 1, comprising:
 - establishing a plurality of working connections, including a working virtual connection;
 - establishing a plurality of protection connections, including a protection virtual connection;
 - transmitting data at the origin node via the working virtual connections;
 - receiving data at the destination node from the working virtual connection;
 - detecting a failure on the working virtual connection;
 - transmitting data at the origin node via the protection virtual connection; and
 - receiving data at the destination node from the protection virtual connection.
5. A method as recited in claim 4, comprising classifying data according to time sensitivity and applying the method of claim 4 only to data with the second highest time sensitivity.
6. The method of claim 1, wherein:
 - the nodes comprise telephone central offices; and
 - the links comprise fiber optic cables.
7. The method of claim 6, wherein the network extends across LATA boundaries.

8. The method of claim 7, wherein the network covers a geographic area comprising contiguous LATAs.
9. The method of claim 8 wherein a connection between central offices in different LATAs is routed through nodes of the network.
10. The method of claim 6, wherein the fiber optic cables comprise multiple fibers.
11. The method of claim 10, wherein the fibers comprise transmission lines supporting multiple channels.
12. The method of claim 11, wherein the channels comprise at least one of a SONET and an SDH channel.
13. The method of claim 1, comprising establishing physical connections between nodes by switching channels and interconnecting fibers at the nodes.
14. The method of claim 1 wherein at least one working virtual connection and its associated protection virtual connection each comprises a label switched path (LSP).
15. The method of claim 14 wherein the working virtual connection and the protection virtual connection each comprises at least one LSP in accordance with GMPLS standards.
16. The method of claim 15 wherein at least one physical connection is shared by multiple LSPs.
17. The method of claim 1 wherein the nodes comprise at least two orders of nodes.
18. The network of claim 17 wherein a higher order node supports at least one lower order node in its local geographic area.

19. The method of claim 18 wherein data flowing between a pair of nodes supported by different higher order nodes is routed through the different higher order nodes.
20. The method of claim 19 wherein data flowing between a pair of nodes supported by different higher order nodes is routed through the different higher order nodes, and through intermediate nodes.
21. The method of claim 17 wherein the functions performed by lower order nodes are also performed by at least some of the higher order nodes.